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A LECTURE
R. Atcheson Esq
ON
with the authors complete
NATURAL, MORAL AND PHYSICAL
GEOGRAPHY,

DELIVERED BEFORE THE HEMMINGFORD MECHANICS
INSTITUTE AND LIBRARY ASSOCIATION,

(CAMPBELL EAST),

WEDNESDAY, 23RD JANUARY, 1856,



FRANCIS DRUMMOND FULFORD, Esq.

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"Scire tuum nihil est, nisi te scire hoc sciat alter."

Pers. Sat. 1, 27.

"Science is not science till revealed."

Dryden.

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(CANADA EAST,)

WEDNESDAY, 23RD JANUARY, 1856,

BY

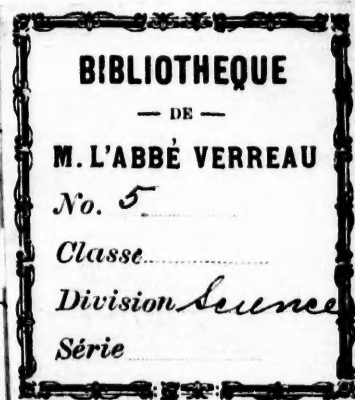
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INTRODUCTORY REMARKS.

THE following Lecture, (which is necessarily in a great measure a compilation from different statistical tables,) was one of a course delivered before the Hemmingford Mechanics Institute and Library Association, during the months of January, February and March. Amongst the other Lecturers were the President of the Society, Julius Scriver, Esq., the Right Reverend the Lord Bishop of Montreal, R. B. Somerville, Esq., Representative of the county, the Mayor of Hemmingford, Dr. Verity, and several strangers who kindly came from a distance. Owing to the unusual severity of the weather this winter, and the scattered nature of the population, the attendance was not so large as might have been assembled under more favorable circumstances; still, however, the number present averaged about 150, the majority coming distances of from four to seven miles. The Institution is still in its infancy, having been started in the early part of 1855. It now numbers about 100 Members, and possesses a well selected Library of between 300 and 400 volumes of the works of standard authors, both British and American. The Society is supported

by a Government grant obtained through the exertions of Mr. Somerville, and by the subscriptions of the Members. The affairs of the Institution are managed by a Committee elected by the Members, who choose a President amongst themselves. The other officers of the Society are the Secretary-Treasurer and the Librarian. When we take into consideration the fact that at the time of the American War, in 1812, there were not above twenty-five inhabitants in a township which has now a population of nearly 7000, composed for the most part of emigrants from the United Kingdom, we may reflect with satisfaction, (without pretending to come into any comparison with the higher offices of religious teaching and training,) upon the steps which they are thus early taking to encourage education, literature and science, thereby laying the surest foundations of peace and morality amongst their homes, so that their mental growth may be in proportion to their worldly prosperity. It is also gratifying to see the interest which is most generally taken in the Institution, the books being eagerly read, and allowed but little repose upon the shelves of the Library. And from the books being carefully selected, and of a superior order,—consisting for the most part of such works as Macaulay's and Alison's Histories, Hallam's Middle Ages, Lord Campbell's Lives of the Lord Chancellors, the Encyclopedia Americana, Lieut. Maury's Scientific Works, the Chemistry of Common Life, Travels and Biographies of distinguished or remarkable persons,—it is to be hoped that much good may result from the efforts of the Institution, amongst the rising generation of a country in itself second to none in the world, and be the means of training them up in such a manner that they may not be ashamed when they meet with the citizens of other

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countries; and that the land, from whence their fathers went forth to struggle with the difficulties of a new world, may look with pride upon her colony in the Far West! not forgetting the words of a learned man long since gone to his rest, that "the reading of books, and the daily occurrences of life, are continually furnishing us with matter for thought and reflection."

F. D. FULFORD.

31st March, 1856.

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LECTURE

ON

NATURAL, MORAL AND PHYSICAL GEOGRAPHY.

THE subject which I intend to bring before your notice this evening, (though from the time allotted to me necessarily in a very brief and superficial manner,) is one of the most important to which we can direct our attention. Last week, several, nay, probably the greater part of those now present, heard a very interesting and able Lecture upon the Human Body: my purpose now is to tell you something about the earth which that body inhabits, the atmosphere it breathes, and the objects by which it is surrounded.

You are well aware that 5860 years ago the Almighty Will framed and designed this terrestrial planet out of nothing; it pleased Him in His supreme wisdom to create this visible world. The decree went forth: disorganized matter became arranged, and filled the great void; even the Ancients, although they had no knowledge of revealed religion, had some superstitious ideas connected with the creation of the world, which have been embodied in the words of a Poet:

"From air, from ocean, from each distant clime,
"The summoned Genii heard the muttered rhyme,
"Each fairy shape the mystic spell obeyed,—
"A perfect world in beauty stood arrayed."

Physical or Natural Geography, the subject of my Lecture this night, treats of the general features upon the face of the earth, the arrangement of the inorganic matter of the globe, and the distribution of organic life, the phenomena of the atmosphere, and its relation to the varied animal and vegetable productions with which the earth is replenished. The limits of this department of science are not strictly defined; the connection is so intimate with Astronomy, Geology, Botany and Zoology, that a trespass upon them is unavoidable in prosecuting this branch of physical enquiry.

The surface of our planet consists of unequal portions of land and water, the water preponderating to a great extent; in fact the fluid proportions are as $\frac{3}{4}$ to $\frac{1}{4}$ solid; a preponderance of land being in the northern hemisphere or division.

To large continuous masses of land is given the name Continent, of which there are four, viz: Europe, Asia, Africa and America; Europe being towards the north, Africa to the south, Asia the east, and America to the west. Some persons have given the name of Continent to Australia, but it is more strictly speaking an immense island, comprising with numerous groupes of islands lying around the fifth division of the globe, under the name Oceapica, from their being situated in the Pacific and Indian Oceans. Islands are those portions of land entirely surrounded by water; a peninsula is a neck of land surrounded on three sides only by water, and an isthmus is the narrow neck washed on two sides which connects two larger masses of land together; capes are extreme points and promontaries; points and headlands are the names given to inferior projections; there are also gulfs, bays, sounds, and many other terms in use to express different portions of the earth or sea.

The flat view of the land as we travel through a comparatively level country, and the side view as seen in cuttings and the sides of mountains, exhibit a great variety of substances of rock differently arranged. Popularly the term rock is applied only to the more solid portions of the globe; geologically speaking it extends to every kind of formation, to loose sands, clays and gravels, as well as to the limestones and granites.

The perforations of the miner extend to scarcely more than 2000 feet below the level of the sea. There is, however, a mine in Bohemia which, before it was abandoned, attained to the great depth of 3545 feet. But in consequence of formations

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having been brought to the surface of the earth by the action of subterranean force, the Geologist has attained a knowledge of the structure of the globe to a depth of about ten miles. Rocks, in the original sense of the word, are composed of minerals which, as they are met with together in different combinations give us either granite or limestone, sandstone or chalk, or some other different formation. What we call soil is, properly speaking, merely the crust of the earth, which, by the action of air and water, has become pulverized. The seeds of plants have been sprinkled there by the winds, have germinated and sprung up; animals and birds have come and fed upon them, and both plants and animals died and decayed away, so that the soil, which we now see upon the surface of the earth, has become a mixture of vegetable and mineral substances.

Different combinations are required for different plants: this we see exemplified every day; we see peas growing luxuriantly, where last year there was a struggling scanty crop of wheat; we see the straw look weak and thin, and know that the lime ingredient of that soil has been exhausted, and must be renewed by artificial means. It is in restoring the exhausted powers of nature, that we see the vast influence which man exercises over the earth whereon he dwells. In this country particularly we see this exemplified, and more so in the neighbouring country of the United States. The settler goes forth and takes all that a generous soil can give, and then goes off to pursue the same course afresh. But in time, as the countries increase in inhabitants, this is not so easily done, and then he has to look to the renovating of the exhausted earth, less rapid in this process, but not less sure than the work of destruction. Science and perseverance restore the land to its original state.

Islands rarely occur alone; of the exception are Ascension and St. Helena, but in general they are connected with the main land. There is no doubt that at some period or other England formed part of the continent of Europe; for the formation of the Cliffs at Dover and the shores on the opposite side at Calais are precisely similar, both being composed of chalk, with the same layers lying in the same order underneath, so that it would seem that the action of the sea had worn away a passage for itself in its attempts to reach the Atlantic. Those islands which rise up alone in the midst of the sea are generally volcanic; and within the tropics we also find coral islands, which consist of the

remains of a departed race of polypi, composed of carbonate of lime secreted from the ocean and cemented into a hard calcareous rock; and which are now the habitation of the coral insect; an insect which cannot exist if left dry, or at a greater depth than from twenty-five to thirty fathoms.

Mountains, to which we are indebted for sublime and savage or picturesque and beautiful scenery, are the loftier protuberances of our planet. They exist either in ranges as we see them in the Green Mountains, or else rising singly out of a dead level, as Belœil. The last are of the most rare occurrence. The highest point of the globe, Dhawalagiri, one of the Himalayas in India, is 28,000 feet above the level of the sea. The highest point on the western continent is the Nevada Sorata in Bolivia, 25,250. 22,900 is the greatest height ever attained by a balloon, which was accomplished in the ascent of Mons. Gay Lussac from Paris in 1804.

	Feet.
Highest flight of the condor,.....	21,000
Highest point reached by Humboldt,.....	19,500
Bushes seen in the Himalaya,.....	17,000
Mines of Potosi,.....	16,080
Good crops of wheat raised in Chinese Tartary,.....	16,000
Highest snow-line of the Himalaya,.....	16,500
Highest snow-line of Andes,.....	15,800
Highest habitation of man in the old world, Table	
Land, Thibet,.....	13,600
Highest inhabited spot on the Andes, farm of Antisana,.....	13,435
Highest point in the southern regions, Mount Erebus	
Volcano,.....	12,400
Highest point of Great Britain, Ben Nevis,.....	4,368
England and Wales, Snowdon,.....	3,571

The above will give you some idea of the relative height of places. Chains of mountains are intersected at their base by valleys. Caverns and fissures frequently occur in mountainous districts, evidences of some violent convulsion having taken place in our planet, or the slow but certain wearing away of time. Among the more notable caves are Fingall's on the coast of Scotland, McAlister's Cave in the Isle of Sky, the Woodman's Cave in the Harz Mountains, the Grotto of Antiparos in the Greek Archipelago, the Mammoth Cave in Kentucky, and one at Schoharie, near Albany, in the State of New York. Almost all important caverns are found in limestone. In the Bible we read of their being used as places of burial: in the 23rd chap. of

Genesis, we read of the aged Patriarch, Abraham,* attending with sorrow upon the funeral rites of his deceased wife Sarah, having previously purchased of the sons of Heth the Cave of Macpelah, as a fit resting place; we also read, further on, in the 18th chapter of Kings, of the old Prophet making the following touching request upon his death bed: "When I am dead, then bury me in the sepulchre wherein the man of God is buried; lay my bones by the side of his bones." But I will quote but one other instance, that of our blessed Lord, who after the agony of his last mortal hour was past, was reverently laid within the recesses of a newly hewn cave. And such caverns are of more than passing interest, for where they have been used as sepulchres, we often find engraved upon them the records of long departed nations, together with various articles of ornamental or domestic use, which afford us a great insight into their manners and customs.

We next come to the consideration of volcanoes, (derived from the name which the Romans gave to their imaginary God of Fire, Vulcan,) which name denotes a peculiar class of mountains, emitting from their summit or sides molten mineral matter, and columns of flame, smoke and ashes; they are aptly termed in various languages burning mountains. They are usually of a conical or sugar loaf form, with a cauldron-like hollow at the summit, called the crater or cup. The most important volcanoes are Stromboli, Vesuvius, Hecla, Etna, Teneriffe, Popocatepetl, Mount Elias, and Catopaxi, varying in height from 2957 to 18,877 feet. What can be more appalling than one of these eruptions! The land at the base of these mountains is usually of a very fertile description, adorned with churches and villas, vineyards and villages. Imagine yourselves for one instant the dwellers in one of these southern paradises, surrounded by every luxuriance that a bounteous nature can lavishly bestow; day after day a solemn stillness and an oppressive enervating heat come on, not one breath of air to cause a ripple upon the glassy deep blue sea, or to give relief to the panting spell-bound vine dressers, for as the danger becomes more imminent, all active exertion is paralyzed: as the basilisk eye of the serpent fascinates its entranced victim, so is the inhabitant of the volcanic district exhausted and unnerved, till at last he is unable to flee from the impending destruction. The mountain has begun to send forth flames and smoke; terrific thun-

derings are heard; even the very foundations of the earth are agitated, trembling as it were with agony at the knowledge of the coming ruin. At last the long-watched for, dreaded hour is come; stream after stream of molten fire pours forth unceasing and unchecked, and large masses of rock are hurled down. The flames abate; a stately column of smoke rises upward silently to heaven, bearing with it the agonizing prayers of widowed mothers, or the piteous cries of orphan babes; unrelenting, undiscriminating, the fatal stream has flowed its course, and where but a few brief hours before the light of plenty shone and nature smiled, all—all is waste. Thankful should we be then that, although beset with many hardships, our lot has been cast in a land where none of these calamities take place.

In connection with this subject I will just make a few remarks upon earthquakes, and then pass on to that portion of the Lecture which relates to water. Between volcanoes and earthquakes there evidently exists some affinity. The concussions arising from earthquakes most frequently take place in volcanic regions, but the shocks are most severe in places distant from active volcanic sites the vents of the latter, acting as a sort of safety valve to the elastic force which, pent up, agitates the crust of the earth in its attempt to escape. Dreadful, as I have described to you, are the effects of eruptions; much more so is an earthquake, for it commences without the slightest warning; the shocks follow in quick succession, the first or second being usually the most tremendous; and almost at the same instant a vast extent of country is involved in disaster from the oscillation. Some of the most notable earthquakes are those which have taken place at Lisbon, Nov. 1st, 1755, which catastrophe destroyed the city and 60,000 inhabitants, shook Europe, and rocked the waters of Lake Ontario, and was over in six minutes. The desolation of Caracacas, March 26th, 1812, felt on the banks of the Magdalena River, occupied less time: in the space of fifty seconds three great shocks shattered the city, and killed 10,000 of its inhabitants, and covered the province with ruins. The earthquake of Gaudaloupe, Feb. 8th, 1842, was felt along a right line from 60 to 70 miles in breadth and 3000 miles in length, extending from the mouth of the Amazon into South Carolina. Though unable to trace the intimate connection of earthquakes, volcanoes, hot waters, the

disengagement of hot noxious vapours, steam, and inflammable gasses, it is impossible to doubt their direct relation-ship and mutual dependance upon one grand phenomenon, a prevailing high temperature in the interior of the earth at an unknown distance from the surface. Thermometrical experiments made in mines show that at a certain depth the thermometer rises and goes on rising proportionably to the depth descended. Baron Humboldt finely records the peculiar impression produced by earthquakes experienced for the first time: "From early childhood we have been habituated to the contrast between the moveable element water and the immoveability of the soil on which we stand. All the evidences of our senses have confirmed this belief; but when suddenly the ground begins to rock beneath us, the feeling of an unknown mysterious power in nature coming into action and shaking the solid globe arises in the mind. The illusion of the whole of our earlier life is annihilated in an instant; we are undeceived as to the repose of nature; we feel ourselves transported to the realm, and made subject to the empire, of destructive unknown powers."

Had I time I might say something upon the devastating effects of land-slips, but which from their name you can sufficiently understand without further delay in noticing them. The most remarkable have been at Mount Gremer, in Savoy, in 1248, when part of the mountain fell, burying five parishes and covering an extent of nine square leagues with its ruins, now called Les Abymes de Myans. In 1806 the Vale of Goldan in Switzerland, with 97 houses and 484 persons, was overwhelmed by the fall of the Rossberg. In 1826, after violent rains following a dry season, an extensive land-slip occurred in the White Mountains, a part of the Alleghanies. On the 20th Dec., 1846, a hill called the Bingeler Kopf on the Rhine, which rises 380 feet above the river, gave way.

Water, one of the most important and abundant substances in nature, very widely diffused, is found in each of the three forms which bodies are capable of assuming: vaporous in the atmosphere, solid in ice and snow, and liquid in rivers and seas. Science deals with it chiefly in the last condition. Water is essentially a compound of two gasses, hydrogen and oxygen, in the proportion of one part of the former to eight of the latter. It seldom occurs, however, in a state of perfect purity, but variously impregnated with ingredients derived from the

atmosphere, from strata in contact with it, or from decomposed and living animal and vegetable substances. Though tasteless and without smell when pure, the foreign ingredients impart to it a peculiar taste, frequently an odour also, which the senses of man may fail to detect, but is readily observed by certain animals: at a great distance in the desert the scent of water is recognized by the camel. The amount of fresh water compared with the salt is utterly insignificant, while the lakes of North America comprise one-half the fresh water on the face of the globe. The universal ocean is salt, and by a process of evaporation a considerable portion of our common salt is procured from its waters. The origin of the saline quality of the ocean is a question involved in obscurity; we merely know that various salts and immense masses of rock salt are constituent parts of the earthly system, a large quantity of which has come in contact with the ocean and been dissolved by its waters. The salt ingredients render sea water more bouyant than fresh, and consequently better adapted for navigation, while a larger area is preserved from being ice bound. Fresh water freezes at the temperature of 32° ; salt water requires a lower temperature to be frozen, or $28\frac{1}{2}^{\circ}$. Besides, the ocean salt water has an extensive distribution on land, in lakes and springs the salts occurring much stronger than in the sea. Amongst the salt lakes are the Caspian Sea; Lakes Aral, Urumah, Toozla, Elton, and the Dead Sea occur in the Asiatic region. Some of these waters are so excessively saline as to irritate the skin. Fish cannot live in them, and if a bird dips on their surface its wings are encrusted with salt on drying. Water appears at the surface of the globe at every temperature from the freezing to the boiling points. The springs of Bath have a temperature of 109 to 117° ; the hottest permanent springs in America range from 204 to 207° , and flow remote from all volcanoes.

The waters of the globe exhibit different colours, which depend upon a variety of circumstances. The true colour of the sea is ultramarine; in the Gulf of Guinea it is white, in the Maldive Islands black; purple, red and rose, in the higher parts of the Mediterranean. Lake waters in mountainous districts are frequently very transparent and of the purest azure hue; others are intensely green, others are brown, and some black. River waters exhibit a similar diversity, even those that are most apart from earthy admixtures. The different hues of clear and

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comparatively shallow waters are perhaps generally referable to the character of their beds. Rivers have their origin in springs, a number of which commonly unite their waters to form a stream, so that it is difficult to single out the head fountain; or they flow from lakes, or have their source in the melting of ice and snow. They are great assistants to civilization, as means of communication between inland nations, and channels of commerce are rendered vastly more efficient in these respects since the discovery of steam, which, overcoming the power of the current, admits of the most rapid floods being readily ascended. From the days of the Ark to the present time rivers and lakes have been used as a great means of transit, whether in the wicker coracle of the ancient Briton or the unwieldy barque of Christopher Columbus.

Rivers are either oceanic or continental: oceanic rivers are those which run into the sea; continental rivers are those which never reach the ocean, but let themselves out into lakes that are unconnected with it, or are absorbed and lost in sandy deserts. The course of rivers in general is very winding, apparently a disadvantage, but in reality one of the numberless acts of wisdom on the part of Providence, for not only is a larger tract of country provided with the means of intercommunication, but the rush of the body of water is prevented, which would render navigation altogether impracticable. The form of the channel, the slope of the bed, and the volume of water, are the elements upon which the velocity of rivers depends. If the banks offered no obstruction, and the water were not checked by friction with the sides and bottom of the bed, the accelerating force of gravity would convert gently flowing streams into irresistible torrents perfectly impassable to the inhabitants of the opposite banks. When water has once received an impulse, by following a descent, the simple pressure of the particles of water upon each other is sufficient to keep it in motion, long after its bed has lost all inclination. A slope of one foot in 200 in the bed of a river renders it unnavigable, a greater inclination produces a rapid, and one still greater, approaching the perpendicular, a cataract. Rapids occur in most principal rivers, the navigation being carried on by means of barges along the banks, or by artificial canals; but in some instances they are surmounted by the aid of the tide. The Richelieu Rapids, opposite Sorel, appear and disappear with the ebb and flow of the tide.

Cataracts depend for their sublimity, not upon the height of the falls, but mainly upon the magnitude of the volume of water. The falls, one of the grandest natural spectacles of the globe, occur, as you are well aware, on the River Niagara, which connects Lake Erie with Lake Ontario, and divides Upper Canada from the State of New York. The river, about $\frac{1}{4}$ of a mile wide, first descends over a rugged limestone bed about 50 feet in less than a mile, forming rapids, and is then thrown down perpendicularly, Goat Island, near the centre of the stream, dividing the falls. The largest of these, on the British side, called the Horse Shoe Fall, from its shape, is 1800 feet broad and 153 in height; the American Fall is 600 feet in breadth and 164 feet high. It has long been supposed that the falls were first situated at the present opening of the gorge, to which the Niagara flowed in a shallow channel from Lake Erie, and that the river has been slowly eating its way backwards through the rocks for a distance of seven miles. It is known that the falls have retreated slowly during the period of modern observation. As to the problem of the falls having retreated seven miles from their original situation at Queenstown, it is very possible, were it not for one fact, viz: that at the rate at which they recede now, they must have commenced marching backwards just 30,000 years before the creation, or six times as far back as the world has been in existence. Were it not for this one objection, I think from the appearance of the banks that we should be justified in stating that the falls had once existed seven miles lower down the river. It was here last summer that I was permitted to witness the grandest sight which perhaps human eyes can behold,—the falls under the influence of a terrible thunder-storm; the two antagonistic elements of fire and water raging furiously together. It was about eight o'clock in the evening, and was as dark as night, save when the sheets of fire burst forth, and the green tint of the falls, crested with white foam stood forth in bold relief. Shortly the storm abated, and like a petted child smiling through its tears, the moon arose and shone over the misty vapour of the fall. Never before in all my travels over land or sea, have I ever beheld anything which can compare in sublimity to the scene which I that night witnessed; nor do I suppose in the whole course of my life, shall I ever be permitted to do so again.

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The inland waters which pass under the name of lakes are most numerous, as well as on the largest scale in the more northerly localities. There is a difference of nearly 17,000 feet between the highest lake, the Sir-i-kol, and the Dead Sea, the lowest. A system of lakes commences in Great Britain, extends through Norway and Sweden along the south coast of the Baltic, through Finland, North Russia, North Siberia to Behring's Strait. The areas of the most important are Sarinas in Finland, 1602 square miles; Wener in Sweden, 2136; Onega, 3280; and Ladoga, 6330, in Russia. A second system extends principally north of the mountain spine of the old world, and includes the Lakes of the Pyrenees, Alps, Apennines, Bavaria, Austrian Empire, Western and Central Asia.

The Caspian Sea, the largest lake in the world, belongs to this band, and has an area of 160,000 square miles,—nearly equal to the Kingdom of Spain; the second in point of extent, Lake Aral, has an area computed at 21,000; the third, Lake Baikal, 1793 feet above the sea, and 1200 miles in circumference. A third system comprises the great Canadian masses of fresh water, with their dependencies, which are continuous, connected by rivers: Lake Superior, 43,000 square miles,—nearly equal to England; Huron, 25,000; Michigan, 25,000; Erie, 11,000; Ontario, 10,000. The different level of these lakes marks the descent of the country, and the inclination of the uniting rivers. The surface of Lake Superior is 627 feet above the level of the sea; Huron and Michigan, 595 feet; Lake Erie, 565; Lake Ontario, 231. A fourth system, north-west of the former, extends from the Lake of the Woods to the icy shores of the Arctic Ocean, including Lake Winnipeg, area 9000 square miles; Athabaska, 3000; Great Slave Lake, 12,000; and Great Bear Lake, 8000.

Independent of these systems there are a vast number of lakes in Northern, Central, and Southern America; some of very considerable extent in Africa, others in China, as the celebrated Mer des Etoiles, the mysterious sources of the Hoango. The water of these lakes is obtained from rivers running into them, or from internal springs.

The Caspian Sea has several shallows, but at one place in the middle no bottom has been found at 2800 feet; Maggiore, 2625; Lake Ontario, the general depth varies from 15 to 500 feet, but in the middle it exceeds 500. The depths of other lakes vary from 66 to 2700.

The waters which surround the island and continental masses form a single ocean, but for convenience are divided into several great sections, an arrangement rendered easy by the irregular distribution of the solid portions of the surface. Thus we have the Arctic, Indian, Atlantic, Pacific, and Antarctic oceanic basins.

The Arctic basin, surrounding the North Pole, is bounded by the northern shores of America, Europe and Asia. Principal branches are Baffin's Bay, the White Sea, Sea of Kara, Gulf of Obi, Behring's Strait.

The Atlantic basin lies between America on the west, Europe and Africa on the east, and the Polar Circles to the north and south. The Equator, an imaginary line running for geographical purposes round the centre of the globe, divides it into the North and South Atlantic. Principal branches, the Baltic, the German Ocean, the Mediterranean and Black Seas, Gulf of Mexico, Caribbean Sea, Gulf of Guinea.

The Indian basin has for its boundaries, Africa on the west, Persia and Hindoostan on the north, the Sunda Isles and New Holland on the east, and the Antarctic Ocean on the south. Principal branches, Red Sea, Persian Gulf, Bay of Bengal.

The Pacific basin is enclosed between America on the east, Asia, the Sunda Isles and New Holland on the west, and the Antarctic Ocean on the south. The Equator divides it also into the North and South Pacific. Principal branches, Sea of China, Yellow Sea, Sea of Japan, Sea of Okhotsk, Gulf of California, Gulf of Panama.

The Antarctic Ocean is confined between the South Pole and the Antarctic Circle.

The Arctic Ocean is closed to navigation in its higher latitudes by eternal frosts; but as the Arctic winters vary in severity, like those of temperate countries, though not so extensively, the area of the ice formed varies accordingly. Hence some navigators have found an open ocean where to others it has presented an impassable icy barrier at the same period in a different year, and have been unable to penetrate to the high latitudes reached by the former. It has long been the object of scientific men to discover, if possible, some passage in these northern regions, which might obviate the present lengthy voyages by way of Cape Horn and the Cape of

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Good Hope. Many brave and daring men have spent much time and suffered much hardship in this undertaking, foremost among whom stands the lamented Sir John Franklin, an account of whose death, after lengthened agony and privation, has lately reached us. A passage has been discovered by Captain McClure, but it is found to answer no practical end. It would seem as though, for some unknown purpose, the Almighty had decreed, "Thus far shalt thou come but no farther."

The Atlantic Ocean rolls in the great valley which separates the eastern shores of America from the western coast of Europe and Africa. This portion of the great deep is the best known of any, as the highway of the world's commerce, perpetually traversed by thousands of merchant vessels, in which millions of property and thousands of lives are embarked. It is the most fickle sea that the mariner can trust his barque upon, for it is composed of successive regions of steady breezes and calms, the latter interrupted by sudden and short squalls and enormous deluges of rain towards the equator, generally descending in a perfectly still state of the atmosphere. I have seen evidences of this myself, for I have been upon this mighty ocean at all seasons of the year; I have been exposed alike to the heat of summer and the cold of winter, and the storms of spring and fall, and never have experienced the same state of weather in making a voyage across. I have crossed in the winter, and found the sea as tranquil as a sheet of glass, and at the same season of the year have seen the deck inches thick in ice and snow. I have risen in the morning in a perfect calm, not a ripple on the water, and I have gone to sleep at night in a perfect hurricane. It is extremely dangerous, from the vast quantities of drift ice and icebergs that are met with at certain seasons of the year. The Indian Ocean has no distinct character excepting its hurricanes and monsoons, or periodical wind storms. The Pacific was so named because, when *first discovered*, it presented a very calm and pacific appearance.

The ocean is subject to three distinct general movements, of waves, tides and currents, the causes of which are independent. The wave movement is of an inconsistent and transitory character, occasioned by the winds; that of the tides is regular and periodical, the result of the attractive influence of the moon modified by that of the sun; while the currents are the effect of various circumstances, and permanently flowing resemble great rivers in

the sea. By experiments made in 1836 it was found that in water 12 feet deep, waves 9 inches high and 4 or 5 feet long did not sensibly affect the water at the bottom: the effect of the strongest gales does not probably extend beyond the depth of 200 feet. The common saying of the waves running mountains high is a popular exaggeration. The highest rise noticed in the Mediterranean is 16 feet, and 20 feet off Australia. Off the Cape of Good Hope, notoriously the cape of storms, 40 feet is considered the extreme height of waves, or 20 feet above and below the general level of the ocean. The highest waves that I ever saw myself in the Atlantic were 86 feet.

The theory of tides, so far as it depends on astronomical causes, is based chiefly on the attraction of the moon, strengthened or weakened, however, by the influence of the sun, according to the relative position of the two planets. Twice every day, or in the interval between successive returns of the moon to the meridian of a given place, which is 24 hours 50½ minutes, the sea flows and ebbs, but much less towards the poles than within the tropics, the latter zone being more directly exposed to the attraction of the moon. The influence of the planets is also varied by their distance from the earth. The oceanic currents, permanent but of unequal force, are the effect of winds, of difference of temperature between different parts of the ocean, of the melting of polar ice, of variations of atmospheric pressure, and other minor circumstances. Drift currents are due to the action of permanent or prevailing winds upon the surface water by friction, impelling its course to leeward; until, meeting with some obstacle, such as land or sand banks, its progress is arrested, and an accumulation of the water produced. In such circumstances a drift current gives rise to a stream current, carrying off the collected waters to restore the equilibrium of the surface of the ocean. The velocity of a drift current is in general half a mile an hour, that of a stream current is usually greater, often amounting to five miles an hour.

The oceanic currents have exerted an important influence in the past history of the globe, and are necessary to its occupation by the human race. The productions of the vegetable kingdom have been widely diffused by the transport of seeds in the waters from one region to another. In like manner animals have been removed involuntarily to a fresh home on floating ice; and canoes of men and women, driven out to sea by the winds, have got

entangled in its powerful streams, and been borne to lands before without a human tenant, but thenceforth to be established in them. Materials drifted across the Atlantic to the Azores confirmed Columbus in his design to navigate it, and led to the gates of a new world being opened. The currents carry the warm water of the tropics to the polar regions, to moderate the cold, and bear the cold water of the poles to the tropics, to moderate the heat. It is the warmth of the gulf stream, conveyed to the north-west of Europe, that renders the climate so mild, clothing Britain in evergreen robes, when in the same latitude the shores of Labrador are encased in ice. Without waves, tides and currents, the ocean, charged with an immense amount of decomposing animal and vegetable matter, would become a stagnant fetid pool, full of noxious exhalations, infect the whole atmosphere, and reduce the habitable parts of the earth to the condition of a desert.

We now come to the consideration of the atmosphere. Unlike the great divisions of land and water, it is imperceptible to the touch, unless in agitation, and only visible when the watery particles are collected in clouds and vapours. It performs the most important functions in the economy of nature, for upon its chemical constitution all organic life absolutely depends, while its mechanical agency, as indicated by winds and temperature, is not less essential to the preservation of the animal, vegetable and human races. The atmosphere consists of dry air and the vapour of water. The air is essentially composed of oxygen and nitrogen in definite proportions, gases which are highly injurious when inhaled separately. It was surmised as early as the age of Aristotle that air had weight, but the truth of this fact was not confirmed till the former part of the seventeenth century. The atmosphere, it is now known, exerts a pressure or weight of about 15 lbs. on every square inch of the earth's surface, which is equal to the weight of a column of mercury one inch square and 30 inches high, or a column of water of the same base, and 34 feet high. The pressure of the atmosphere was noticed by Galileo, but demonstrated by his pupil Toricelli, who invented the barometer, a simple instrument consisting of a column of mercury poised or pressed upwards into a vacuum by the weight of the atmosphere. The pressure varies owing to fluctuations of temperature, &c. This is indicated by the barometer. The mercury is commonly high in calm and fair

weather; it falls when it is wet and stormy, and hence the use of the instrument as a weather glass.

The height of the atmosphere is not known, but it is supposed to extend to about fifty miles. Yet by far the greater part of it is within fifteen or twenty miles, and at a much less distance it becomes so rarified as to be incapable of supporting life, and as we descend into mines below the surface of the earth the pressure is increased in an equal proportion. The atmosphere is naturally colourless; the hue of the sky, however, presents all imaginable shades, from deep blue in the heavens to paler tinges and complete whiteness towards the horizon.

Rain is produced by the continued condensation of vapour. Rain may have begun to fall, and yet not reach the ground, being changed back again into invisible vapour before it reaches the earth. For the same reason rain drops may become smaller in their descent, a portion being evaporated; and less rain arrives at the general surface than at a certain height. Usually the drops increase in their descent, bringing with them the low temperature of the upper regions, and condensing on their surface the vapour in the lower and warmer strata of the atmosphere. More rain falls in mountainous regions than level districts, because mountains arrest the course of the clouds, and a condensation of vapour ensues from collision with their cold summits. There are extensive tracts of the globe in which rain is unknown; in some districts it falls periodically, and in others it may be said to be constant.

Snow is nothing more than the frozen visible vapour of which the clouds are composed. A quantity of very minute crystals of ice having been formed, they are enlarged by the condensation and freezing of vapour, and, merging together, constitute flakes which increase in size during the period of their descent. Snow falls to the ground when the temperature of the atmosphere down to the earth's surface is sufficiently cold, but if the lower strata of air are too warm, it melts in traversing them, and we have rain below while it snows above.

Dew, the moisture thrown off during the night in the form of minute globules on the surface of plants and other bodies, is the effect of those bodies being cooled by nocturnal radiation, several degrees below the temperature of the air in contact with them; chilled by the cold embrace, the aerial particles are no longer able to support the same quantity of dampness in the

state of transparent vapor, and a portion is deposited. It is precisely the same phenomenon occurring on a great scale, as the forming of vapor on a decanter of water fresh filled from the well, and brought into a heated room.

Hoarfrost is the ice of dew: when the objects upon which the vapor of water is deposited are cooled below 32° , the freezing point, the vapor can be no longer deposited in a fluid state, but in the form of icicles.

That meteoric display which is so frequently seen in our heavens, the Aurora Borealis or Northern Light, is unquestionably of electro-magnetic origin, for it may be artificially imitated. Auroral displays are very diversified, not only at different periods, but the same exhibition usually shifts through a succession of phases; sometimes only flicking lights are seen streaming up from beneath the horizon, at other times a perfect arch stretching like a rainbow across the heavens. The arch seldom remains stationary for more than a few minutes, but extends itself laterally, or rises and falls, or breaks in various places, or bends like a ribbon exposed to the wind, while rays of almost every hue are incessantly darting from it towards the zenith, the merry dancers of the northern sky.

We now come to treat of the geographical distribution of vegetables, in doing which we have to mark the general arrangements indicated, and the agencies that have evidently operated in promoting the diffusion of floral tribes. Vegetation occurs over the whole globe, therefore under the most opposite conditions. Plants flourish in the bosom of the ocean, as well as on land, under the extremes of cold and heat, on the hardest rocks and softest plains, amidst the perpetual snow of lofty mountains and in springs at the temperature of boiling water, in situations never penetrated by the sun's rays, as caverns, mines, the walls of the dark vaults of death, as well as freely exposed to the influence of light and air. There is only one state which seems fatal to the existence of vegetable life, the entire absence of damp; and here I will pause to point out for one moment an instance of the wonderful economy of nature, with regard to the sustenance of plants. As I told you just now the air was composed of the gases hydrogen and nitrogen; combined with these is a small portion of carbonic acid gas, most hurtful to man, but most necessary to the existence of plants. So, to make this small portion, comparatively speaking, effective, plants have

been provided all over their leaves with numberless pores to absorb this gas, and to create a further supply. After a man has breathed in a lung full of fresh air, the refuse air that he breathes out again is mainly composed of this carbonic acid gas, an ingredient of the hydrogen and nitrogen, which are necessary for his existence. The known number of species in the vegetable kingdom has been gradually enlarged by the progress of maritime and inland discovery, but owing to great districts of the globe not having yet been explored by the botanists, the interior of Africa and Australia with sections of America, Asia, and Oceanica, it is impossible to state the exact number. That they have considerably increased, however, will be shown from the following facts: the Greek, Roman, and Arabian botanists knew of 1400 species; we know of about 100,000. Vegetable forms are divided into three great classes, which differ materially in their structure.

1st. Those which have no flowers, properly so speaking: mosses, lichens, fungi, and ferns; as distinguished from those which are flower bearing, to which the following classes belong.

2nd. Those which have stems increasing from within, as the numerous grasses, lilies, and palm family.

3rd. Those plants which have stems growing from without, the most perfect, beautiful, and numerous class, embracing the forest trees and most flowering shrubs and herbs.

Plants capable of extended naturalization, and serviceable as articles of food, or luxury, have been widely disseminated by the human race in their migrations. The corn species afford a striking example. These important grasses, known to the Ancients, wheat, barley, oats and rye, were the gifts of the old world to the new. They are also importations into Europe, but the loose reports of the Ancients, and the diligent researches of the Moderns, alike leave us in ignorance of their native seat. Probability points to the conclusion that they have spread from the neighbourhood of the great rivers of Western Asia, the primitive location of the human family; and it is not impossible that in that imperfectly explored land, or further eastward, some of the cereals may be found growing spontaneously. The first wheat sown in North America consisted of a few grains found by a negro slave of Cortes, among the rice taken for the support of his army.

The arrangement of the animal kingdom distributes the forms of animal life into four grand divisions, which are subdivided into nineteen orders:

1stly. Animals having a spinal column like the back bone, which, with its termination, the skull, encloses and protects the brain and spinal cord, the central organs of the nervous system.

2ndly. Animals of a soft texture and no skeleton, having the muscles attached to the skin, which produces in many species stony coverings or shells, as the snail or oyster.

3rdly. Animals consisting of a number of joints or rings, soft or hard, supplying the place of a skeleton, like a worm.

4thly. Plant animals, from the resemblance of some families to vegetable forms such, as the coral, tape-worm, madrepores, &c., those little creatures invisible to the naked eye, which abound in stagnant water, mud and rain. These are the lowest order of living things.

Fish, the cold-blooded inhabitants of the water, form one great subdivision; and reptiles occupy the lowest rank among animals on the earth, having spines. They diminish in number, magnitude, and noxiousness, from the equator to the poles, and have their greatest development in the middle of South America, owing to the combined circumstances of intense heat, enormous forests, marshes and rivers. Each family is represented in the old and new world, but not a single species appears to belong to both. Of the serpent tribe the rattle snakes of four species are exclusively American; the larger boas are so likewise; the smaller kinds belong to Europe, with the exception, we believe of the Emerald Isle, which is specially exempt; whilst the pythons are African and Asiatic. Of crocodilians, consisting of three races, the crocodile proper is distributed in the old and new worlds, but the species differ; the alligator or cayman is confined to America, and the gavia is limited to the Ganges, and other large rivers of India.

The ascertained number of species belonging to the four divisions of reptiles is as follows:

Tortoises,	69
Lizards,	203
Serpents,	265
Frogs,	120

Total,..... 657

Birds, the members of the succeeding order, have a more perfect organization; several species are very widely disseminated: this is the case, for instance, with the house sparrow, common crow, jay, raven, osprey, and others; but the majority of the species are restricted, by geographical laws, to particular districts, and have in many instances a very local existence: the far famed birds of Paradise are confined to New Guinea and the neighbouring islands; the condor never leaves the Andes of South America; the great eagle remains among the ridges of the Alps; parroquets are chiefly to be found within the tropics; the albatross is seen skimming the surface of the ocean on approaching the latitude of 40° ; the common grouse, the yellow and pied wagtails, and the English starling, are alone known in Great Britain. These are only a few examples of limited distribution. The most beautiful varieties of birds are found within the tropics, where also the number of species and individuals is the greatest, except in the instance of two families, the swimmers and waders, which in both respects are the most numerous in the more northern regions.

Quadrupeds stand at the head of the brute creation, distributed into eight great groups: 1st, four handed animals, as monkeys, apes; 2nd, flesh eaters, as mole, glutton, civet, bear, hyena, cat, in which last tribe the sanguinary development is at its height in the lion, tiger, and sea otter; 3rd, pouched animals, as the opossums and kangaroos; 4th, gnawers, beaver, porcupine, squirrel; 5th, toothless, as the armadillo and sloth; 6th, thick skinned, elephant, rhinoceros, hippopotamus, zebra, tapir, &c.; 7th, chewing the cud, camel, ox, goat, sheep, deer, antelope, giraffe; 8th, the whale tribe, including whales, dolphins, narwhal, seal, porpoise.

Carnivorous animals of some kind or other are spread over the entire globe, as their natural food exists in every accessible region. The dog, properly so called, domesticated by man, has attended him everywhere, his faithful companion and friend; but there are two remarkable instances of the existence of dogs in a wild state: the dhole of India, and the dingo of Australia, besides a half reclaimed race among the Indians of North America, and another partially tamed in South America. The jackal, the characteristic dog of Africa, ranges through its entire north to India, and from Abyssinia to the Caspian Sea. The wolf is

more widely distributed in America, from beyond the Arctic circle to near the Isthmus of Panama; in the old world from the same northern limit to Egypt, Arabia and India, and from Spain on the west to the eastern shores of the continent, not however, occurring in India beyond the Ganges. But of all members of the dog tribe, omitting the domesticated, the fox is the most extensively diffused, from the highest northern latitudes, through a great part of Europe, Asia, Africa, and America. The various species are provincial; the red fox, distinct from the European, inhabits the forest district of North America; the black fox the Siberian woodlands; and the white or arctic fox, the polar regions, coming down in mid-winter for food to near the parallel of 50° , in the western world. Cats: Europe has no representative of the feline tribe in a state of wildness, but the cat and lynx. The wild cat occurs in most of its woody countries, and is found also in Northern Asia, India, and Southern Africa. The feline tribe appears to have no representative whatever in Australia and Oceania. But the tropical regions of both continents are occupied by powerful animals of the class, lions, tigers, leopards and lynxes. The African lion is found through the whole of that vast peninsula, excluding the Libyan Desert, the Nile country, and some adjacent districts. The Asiatic lion specifically distinct, has much smaller domain, stretching from Persia into India; the American lion, the puma, a widely different animal, ranges from Patagonia to the Canadian lakes. The tiger is exclusively Asiatic, occupying the southern eastern countries, with the islands of Sumatra and Java, appearing westward in Persia, and northward in the vicinity of Lake Baikal. The leopard and panther, two closely related animals, if not specifically the same, chiefly inhabit Senegambia, the Oases of the Great Desert, India and its islands. The jaguar, sometimes called the American panther, a distinct animal, is peculiar to the south part of the continent, and is principally found in Brazil and Paraguay. Lynxes are common to Europe, Asia, Africa and America, but the species are different. The thick-skinned group comprises the largest and most powerful of all land animals, with some of the most useful as domesticated by man: they consist of the elephant, rhinoceros and hippopotamus. The remaining important form are those of the horse and hog; and the group of ruminating animals, characterized in their internal economy by four stomachs, for the purpose of chewing

the cud, comprehends various tribes remarkable for elegance of form, and utility to man, as articles of food and beasts of burden, in climates of the most extreme heat and cold; the camels, the llamas, the giraffes, deers, musk deers, antelopes, goats, sheep, and oxen.

The last group are the whale kind. Contrasting the quadrupeds of the western and eastern hemispheres, we find a much smaller proportion of those that are useful to man in the former than in the latter. The llama, turkey, some sheep and dogs, comprise all the important contributions made by America to the domestic stock of animals, which are vastly inferior to the domesticated races it has received from the old world. In point also of size, courage and power, the land animals in the new world are inferior to those of the old. The conclusion that we may draw from the facts of zoological geography are the same as those drawn from the circumstances of vegetable distribution, viz: that certain tribes of the animal creation were originally placed in particular regions, and have since remained attached to them, or to some extent been dispersed according as their powers of locomotion, their capacity to endure change of climate, and the absence of physical obstacles to migration, have enabled them to wander. Man has largely contributed, voluntarily and involuntarily, to extend the sphere of various races, diffusing the domestic tribes through the civilized world, and planting them on lonely islands, as a source of supply to future visitors. But man, on the other hand, has immensely restricted or modified the natural sphere of many animals both of the useful and dangerous class. The Asiatic lion, now confined to the country beyond the Euphrates, once roamed in numbers through Palestine, Syria, Asia Minor, Macedonia and Thrace. The bear, beaver, and the wolf, once had their habitation in Britain. The presence of civilized man in North America has had a similar marked influence upon the natural boundaries of the brute creation. The buffalo, or more properly the bison, once inhabited the Carolinas, and indeed existed through nearly the whole extent of the United States. But as the settler has pushed westward, the animal has lost part of his old domain, and chiefly occurs in force on the plains of the Missouri or on the Pacific side of the Rocky Mountains. The limits of the fur-bearing animals have undergone a similar alteration; and when from 80 to 90,000 beaver skins, and upwards of half a million skins of the musk-rat, are annually imported into

Europe, it is obvious that these races must ultimately disappear before the persevering pursuit of the hunter.

Man is properly separated from all other members of the animal kingdom, and regarded as forming an order by himself, comprising a single species exhibiting many varieties. The most inferior specimen of the human race is distinguished from any mere animal by a difference immensely greater than the change which species can be supposed to have undergone in the longest periods of time, and under the influence of the most varied circumstances. The characteristics of the species are, erect, two handed, unarmed, rational, endowed with speech, a prominent chin, four incisor teeth above and below. Owing mainly to the flexibility of his constitution, although obtaining much artificial aid, man can subsist under the greatest extremes of climate: the Esquimaux endure the cold between the parallels of 70 and 80; the African negroes subsist under the burning sun of the equator, while Europeans, accustomed to an intermediate temperature, have borne the rigour of the highest accessible latitude and the fiercest heat of the torrid zone. The human race are not confined to any particular kind of food, but subsist in different situations with equal facility on varied diet; vegetables are the chief food of the natives within the tropics, and animals of the polar tribes, both sources, with no great disproportion, contributing to support the inhabitants of temperate climates. Man is thus adapted for a very wide geographical range, and fitted to occupy very discordant regions. In high latitudes, where a mantle of snow covers the ground through the greater portion of the year, and vegetation is very scanty, entire tribes live on fish and seals; towards the equator, where vegetation flourishes most, vast numbers thrive with no other articles of support than cocoa nuts, bananas, yams, and rice; in the intermediate district, the special region of the cereals, and where animal food can as readily be procured, a mixed diet obtains.

Respecting the aggregate number of individuals, the estimates made are approximations only, and are very discordant. The following estimate, however, of Maltebrun will shew the relative proportions of the different continents:

Europe,	...	...	...	...	170,000,000
Asia,	...	...	...	...	320,000,000
Africa,	...	...	...	...	70,000,000
America,	...	...	...	...	45,000,000
Oceanica,	...	...	...	...	20,000,000
					<u>635,000,000</u>

The total is raised much higher by other authorities, and probably 900,000,000 is the closest approximation. The leading physical differences observable among mankind refer to varieties of strength, stature, proportion of the limbs, texture of the skin, character of the hair, colour and form of the skull. Differences occur with reference to the proportional size of parts of the bony skeleton, the texture of the skin and hair: thus examples are common in the negro tribes of the broad flat foot, projecting heel, cucumber shins, and of the greater length of the fore arm, measured in proportion to the upper arm and height of the body. The skin is also softer and more velvety, a characteristic of some of the South Sea Islanders. The hair has likewise that peculiar character which has led to the African nations being styled in general woolly-haired, fine, wiry and crisp, while that of the Mongolian tribes is strong, straight, and scanty, and that of Europeans, soft, long and flowing. Differences of complexion form the most obvious distinctions which subsist among mankind, and have been most relied on as evidencing a descent from different original stocks. Omitting exceptional cases, there is a correspondence maintained between the colouring of the skin, eyes and hair, which renders their dependence upon the same colouring matter highly probable. Light hair is generally in alliance with light blue or grey eyes; but the hue of the hair and of the skin have an analogy which is almost invariable, the fair transparent skin, which frequently assumes a ruddy tint, being connected with light hair, and the dark complexioned skin with dark hair. The argument against the unity of mankind founded upon the differences of colour is completely exploded by the consideration that varieties of hue quite as strongly marked occur in animals of the same species.

The last important physical diversity apparent among mankind refers to the form of the skull, which, very remarkably varies, presenting several well defined shapes, distinctive of great groups of the human population. The limit of the civilized man's existence, in the most favourable circumstances, very rarely extends to one century, though most European nations supply a few instances of that boundary being exceeded. That the average duration of life should be much inferior among the barbarous races, as compared with the civilized, is adequately explained by a precarious mode of life, physical hardships, ignorance of remedies in sickness, and of the habits favourable or adverse to vitality.

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There are 3864 known languages and dialects on the earth, distributed as follows :

Europe.	587
Asia,	937
Africa,	276
America,	1624
Oceanica,	240

The specific identity of mankind by no means solves the problem of their origin, whether they have all sprung from a single pair, or whether triplicates, triplicates, or other multiples of pairs were brought into being in different regions, formed much alike, that there should be no specific difference between them. Some very eminent writers conceive that the latter alternative may be held, the two first inhabitants of Eden being regarded as the progenitors only of the race from whence sprung the Hebrew family, in harmony with the announcement of the Scriptures ; but the theory appears to be improbable, and it is quite unnecessary to explain the dispersion of the species. Mankind have not, like plants or animals, a constitution adapted simply to particular geographical localities, and there is no great difficulty connected with the idea of their diffusion from the location of a single pair. The new world might readily receive inhabitants from the old across the narrow strait which separates them, and likewise by the chain of the Japan, Kurile and Aleutian Archipelagoes, a series of stepping stones extending from China to the north west coast. Canoes diverted by winds and current from their course, have borne their occupants into perpetual exile, and contributed to stock remote islands of the ocean with a human population.

I have now handed you down step by step through the different stages of the physical world. I have placed the different wonders of God before you, as shewn in the creation of his various works. I have endeavoured, as well as my inadequate powers will permit, to put before you what may be termed the economy of nature, the extraordinary manner in which everything is destined to fulfil some useful end. I have shewn how the refuse of one thing forms the vitality of another ; how the northern ice cools the heated atmosphere of the tropics ; how the tortuous banks of rivers restrain their impetuous streams. All these give silent testimony to the wonderful fore-sight and design of some great first cause, and so perfect are all these

works for the due performance of their peculiar duties, that it is impossible to point out any one way in which they could be improved, and this idea has been beautifully embodied by the Poet Shakspear in the following words :

To gild refined gold, to paint the lily,
To throw a perfume on the violet,
To smooth the ice, or add another hue
Unto the rainbow, or with taper light to seek,
To garnish the beauteous eye of heaven,
Is wasteful and ridiculous excess.

And now, in conclusion, if what I have said this night should prove the means of inciting any one amongst you to search out and study these subjects for himself, to such a one I would say, Lose no time ; for on his death bed, one of England's wisest and most learned men, Sir Isaac Newton, said : " Is science your pursuit ? The great ocean of truth lies expanded before you. I do not know," he says, " I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea shore, finding sometimes a brighter pebble or smoother shell than ordinary, while the great ocean of truth lay undiscovered before me."

